



Carrageenan is found in some products, including both conventional and organic soy milk, heavy cream, chocolate milk and ice cream.

Controversy Over Processed Organics

A non-organic ingredient taken out of infant formula, but remains on market

By Terry Shistar, Ph.D.

In Albuquerque in May, the National Organic Standards Board (NOSB) voted to allow the continued use of carrageenan with its cancer causing contaminant in organic food, while taking it out of infant formula. The vote came following conflicting testimony and considerable debate. The debate on carrageenan has become part of the larger question of whether processed food approved by certifiers and labeled with the USDA organic seal should be able to include non-organic ingredients that are not essential to its production and bring with it substantial safety and environmental issues and uncertainties.

The NOSB must apply criteria in the *Organic Foods Production Act* (OFPA) in deciding whether a synthetic or non-organic nonsynthetic material may be added to organic food. The criteria require that such a substance is not harmful to human health and the environment, taking into account its manufacture, use, and disposal; that it be essential to organic production; and that it be compatible with a system of sustainable and organic production.

Forms of Carrageenan and Contamination

Carrageenan was originally approved for use as a stabilizer and thickener in organic products in 1995, and has been reapproved each time it has come up for sunset review on a five year cycle. In the past, the NOSB has known from a technical review performed for the board that low molecular weight carrageenan, also known as “degraded carrageenan” or “poligeenan,” may cause cancer, inflammation, and ulceration of the colon. The International Agency for Research on Cancer (IARC), created by the World Health Organization of the United Nations, classified poligeenan as Group 2B, “Possibly carcinogenic to humans,” in 1993. This finding means that the agency found adequate evidence that poligeenan causes cancer in animals, but did not have studies on humans (typical in cancer classification since testing on humans is outlawed) to justify a higher classification. The findings on lower molecular weight carrageenan with poligeenan were considered irrelevant to the higher molecular weight food use carrageenan until data was brought to the board that shows the presence of poligeenan there as well.



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The Undisputed Science

The following scientific findings are unchallenged:

- Low molecular weight carrageenan, also known as poligeenan, causes inflammation and ulceration of the digestive system.
- Poligeenan is classified by the International Agency for Research on Cancer as a “possible human carcinogen” (Group 2B).
- Food-grade carrageenan contains poligeenan in concentrations varying from sample to sample, but at levels that cannot be reliably limited or measured.
- No known quantity of a carcinogen can be assumed to be without carcinogenic effect.

The conclusion from this undisputed science is that we must treat food-grade carrageenan as a carcinogen.

Elements of the Debate

Two elements to the debate at the meeting in Albuquerque were the (i) “need” (or “essentiality,” as required in the *Organic Foods Production Act* (OFPA)) for carrageenan as a stabilizer and thickener in organic products, and (ii) science concerning the health effects. The NOSB heard comments from several producers that used carrageenan in some of their products, most of whom wanted to ensure that it would still be available for them to use. On the other hand, some of those food processors said that they had already minimized or planned to eliminate the use of carrageenan in their organic products.

The Science

The scientific part of the debate centers on the relevance of the science concerning poligeenan to the health effects of carrageenan. This article focuses on scientific results that are well-accepted and non-controversial. No one challenged the conclusion that poligeenan causes inflammation and ulceration of the digestive system. It has, in fact, been widely used to induce inflammation in immune system experiments. Nor did anyone challenge IARC’s classification of poligeenan as a “possible human carcinogen.” The new (since last approved by the NOSB) Technical Evaluation Report¹ (TR) performed for the NOSB refers to studies showing that consuming food grade carrageenan may, through contamination with poligeenan or metabolism of carrageenan to lower molecular weight forms, result in the same health effects as consuming poligeenan.

How Carrageenan Is Made

Carrageenan is derived from various species of red seaweeds. The term “carrageenan” actually refers to

a family of linear polysaccharides, made up of disaccharide units. There are several carrageenans with different molecular structures. The most common in food applications are known as iota, kappa, and lambda carrageenans, differing in “degree of sulfation, extent of branching, solubility, cation binding, and ability to form gels under different conditions.”² Different seaweeds contain different combinations of iota, kappa, and lambda carrageenans, which are extracted using several different chemical extraction methods resulting in chemical changes to the carrageenan molecules.³ In addition to the variation in forms among the types of carrageenan, any given form may exist in a variety of molecular weights, depending on the number of disaccharide units in particular polysaccharide molecules. Therefore, the molecular weight is expressed as an average, which may differ from sample to sample. The molecular weight is important for two reasons: (i) very low molecular weight carrageenan (below 10,000 daltons) is absorbed through the intestinal wall, and (ii) the experimental evidence linking carrageenan to adverse health impacts mostly involves experiments with “poligeenan” (variously defined as carrageenan with molecular weight 10,000-20,000, 20,000-40,000, up to 80,000 daltons). Yet another related issue is the fact that infants absorb larger molecules of carrageenan through their intestines.⁴

Since molecular weight is such a crucial issue, it is not surprising that the discussion at the NOSB meeting focused on the relevance of the data on poligeenan to the decision on carrageenan. The Handling Subcommittee of the NOSB, which voted unanimously with one absent to relist carrageenan without restrictions, supported the position that carrageenan is not poligeenan, and therefore the evidence concerning cancer and other health effects caused by poligeenan was, in the subcommittee members’ judgment, irrelevant to the decision.



Check your labels closely to make sure carrageenan isn’t included in the product’s ingredient list. It may be found in both processed organic and conventional foods. Photo courtesy www.migrainemindset.blogspot.com



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Joanne Tobacman, M.D., a physician and scientist at the University of Illinois College of Medicine who has been studying the effects of carrageenan for almost 20 years, was cited in the TR and appeared in person to testify. She has published 18 peer-reviewed papers addressing the biological effects of carrageenan, mostly funded by the National Institutes of Health and the Veterans' Administration. Among her publications is a 2001 review in *Environmental Health Perspectives* of the harmful effects of carrageenan on the gastrointestinal system, which presented evidence that low molecular weight carrageenan may be present in food grade carrageenan and may be produced in the digestion of carrageenan in food. *Environmental Health Perspectives* is a publication of the National Institute of Environmental Health Sciences, whose publications OFPA requires the NOSB to review in making decisions concerning listing materials on the National List.



The presence of poligeenan in carrageenan is supported by published data on the distribution of molecular weights in carrageenan.⁵ These studies show that food-grade carrageenan contains varying amounts of poligeenan, in the neighborhood of 5%. Despite the published estimates of the distribution of molecular weights in carrageenan, the industry has been unable to devise a practical method of meeting and verifying a 5% limitation on poligeenan. Recently, the carrageenan industry trade group, Marinalg International, reported:

*In 2004 the European Commission published new specifications for carrageenan and PES [processed Eucheuma seaweed] requiring that carrageenan and PES for use in food must not contain more than 5% molar mass with molecular weight less than 50,000 Da.... After eight years of planning, experimentation, and analysis (2003 to 2011), Marinalg has been unable to reliably measure this new specification in the laboratories of its members, its customers, or in independent laboratories.*⁶

The fact that any poligeenan is in food-grade carrageenan is significant because of the adverse health effects associated with poligeenan, particularly cancer. Since no known quantity of a carcinogen can be assumed to be without carcinogenic effect, any quantity of poligeenan—and thus any quantity of carrageenan—must be taken to be harmful by regulators and consumers.

Environmental Impacts

While the health effects of consuming carrageenan are most nota-

ble, there are also ecological impacts that OFPA requires the NOSB to consider. Overharvesting of a cold water species of seaweeds used to make carrageenan has resulted in a population crash of the wild species. Warm water species are cultivated and present “serious bio-invasive risks for nearby marine communities”⁷—not only spreading beyond cultivation sites, but also smothering coral ecosystems and contributing to reef degradation. Other adverse impacts are detailed in the TR (lines 469-551). Furthermore, “The industrial manufacture of carrageenan is a process that produces large amounts of alkaline waste water which may pose environmental problems.”⁸

Take Action

Because the process of review by the NOSB is a transparent process with full disclosure, providing public access to the underlying science and the meeting notes of subcommittee deliberations (see NOSB webpage on the Agricultural Marketing Service, USDA website), organic consumers are able to make informed decisions in the marketplace and influence NOSB decisions. With this information, consumers can choose to seek out or avoid ingredients. In this case, the Cornucopia Institute has created a shopping guide to help consumers avoid this ingredient, which is available at www.cornucopia.org/shopping-guide-to-avoiding-organic-foods-with-carrageenan (see chart on the next page).

In this context, organic can increasingly become a food sector in which producers, handlers, and consumers are able to avoid uncertainty and, when industry and academic scientists differ, embrace precaution and the precautionary principle.

A fully cited version of this article is available online at www.beyondpesticides.org/infoservices/pesticidesandyou.



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Guide to Organic Products Containing Carrageenan

The following is a list of products with and without carrageenan. (Source: *Cornucopia Institute*)

		Contains Carrageenan	Does Not Contain Carrageenan
Dairy Products	Chocolate Milk		
	<p>Clover Stornetta, Horizon, Kalona Supernatural (Kalona has committed to removing carrageenan, and will be carrageenan-free by the end of 2012. Check ingredients list), Natural By Nature, Organic Valley, Publix, Simply Smart</p>	<p>Castle Rock Organic Farms, Crystal Ball Farms, Strafford Organic Creamery, Tricking Springs Farms</p>	
	Ice Cream		
	<p>Julie's (mint fudge, mocha fudge and peanut butter fudge flavors only)</p>	<p>Alden's, Ben and Jerry's Organic, Castle Rock Organic Farms, Crystal Ball Farms, Green and Black's Organic, Julie's (all flavors except mint fudge, mocha java and peanut butter fudge), Publix, Stonyfield, Strafford Organic Creamery, Strauss Family Creamery, Three Twins</p>	
	Yogurt		
	<p>Stonyfield (Oikos – caramel flavor only, Squeezers – all flavors), Horizon (Tuberz™)</p>	<p>Butterworks, Cedar Summit (pourable), Crystal Balls Farm, Hails Family Farm, Hawthorne Valley Farm, Horizon (all except Tuberz™), Kalona Supernatural, Nancy's, Organic Valley (pourable), Redwood Hill Farms, Seven Stars, Stonyfield (all except caramel Oikos and Squeezers), Straus Family Creamery, Wallaby Organic</p>	
	Sour Cream		
	<p>Horizon (lowfat), Natural By Nature, Publix</p>	<p>365 Whole Foods, Clover Stornetta, Friendship Brand, Horizon (regular only), Kalona Supernatural, Organic Valley (regular and lowfat), Nancy's, Strauss Family Creamery, Wallaby Organic</p>	
Non-Dairy Alternatives	Almond Milk		
	<p>Almond Breeze (Blue Diamond), Pacific Foods, So Delicious, Trader Joe's (aseptic)</p>	<p>365 Whole Foods, Almond Dream, Natura (8 flavors), OMilk NYC, Silk PureAlmond (including chocolate-flavored), Westsoy, Trader Joe's (refrigerated)</p>	
	Soy Milk		
	<p>365 Whole Foods, 8th Continent, Earth Balance, Great Value (Walmart), Nature's Promise, O Organics – Safeway (refrigerated original and vanilla), Organic Valley, Pearl Soymilk (Kikkoman), Pacific Foods, Publix, Silk, Soy Dream, Soy Slender, Sunrich, Trader Joe's, Vermont Soy, Vitasoy, Wegman's, Westsoy (Organic Plus, Nonfat), Wildwood, ZenSoy</p>	<p>Eden Soy (Eden Foods has committed to removing carrageenan from all its products. Currently, most soymilk is already carrageenan-free, but EdenBlend and chocolate flavored soymilk still contains carrageenan. Check ingredients list), Westsoy (original, unsweetened, lowfat)</p>	
Other	Deli Meat		
	<p>Applegate (Packaged and Sliced: Roasted Chicken, Turkey Breast, Roasted Turkey Breast, Smoked Chicken, Smoked Turkey Breast)</p>	<p>Applegate (Roast Beef, Genoa Salami, Uncured Ham)</p>	
	Orange Juice		
	<p>Knudsen's (Yumberry), Lakewood (Acai Amazon Berry and Coconut)</p>	<p>Apple and Eve, Columbia Gorge, Honest Kids, Knudsen's (all flavors except Yumberry), Lakewood (all flavors except Acai Amazon Berry and Coconut), Organic Valley, Publix, Santa Cruz, Uncle Matt's</p>	
Organic Pizza			
	<p>Annie's Organic Frozen Pizza</p>	<p>365 Whole Foods, Amy's (70% organic), Publix, Rising Moon Organics (70% organic), Trader Joe's</p>	

Endnotes

1. "Carrageenan," October 3, 2011 Technical Evaluation Report, Compiled by ICF for the USDA National Organic Program, available online at <http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateJ&page=NOPNationalList>
2. Tobacman, J. K. 2001. Review of harmful gastrointestinal effects of carrageenan in animal experiments. *Environ Health Perspect* 109:983–994.
3. McHugh, 2003. A guide to the seaweed industry: FAO fisheries technical paper 441. Food and agriculture organization of the United Nations, Rome. Available online at <http://www.fao.org/docrep/006/y4765e/y4765e0a.htm>
4. The Joint FAO/WHO expert committee on food additives states that, "based on the information available, it is inadvisable to use carrageenan or processed eucheuma seaweed in infant formulas."
5. Bixler, H.J. 1996. Recent developments in manufacturing and marketing carrageenan. *Hydrobiologia* 326/327: 35-57. Online at: http://www.marinalg.org/PDF/Bixler__1996__Recent_developments..._Hydrobiologia_326-327__35-57.PDF Hoffmann, R.A., A.L. Russell, and M.J. Gidley, 1996. Molecular weight distribution of carrageenans: characterization of commercial stabilisers and effect of cation depletion on depolymerisation. *Gums and Stabilizers for the Food Industry* 8, Phillips, G.O., P.A. Williams, and D.J. Wedlock, eds. IRL Press, Oxford, 137-148. Yoshitaka Uno, Toshio Omoto, Yasunori Goto, Iwao Asai, Mikio Nakamura and Tamio Maitani, 2001. Molecular weight distribution of carrageenans studied by a combined gel permeation/inductively coupled plasma (GPC/ICP) method. *Food Additives and Contaminants*, 18(9): 763-772. Weiner, M.L., D. Nuber, W.R. Blakemore, J.F. Harriman, S.M. Cohen, 2006. A 90-day dietary study on kappa carrageenan with emphasis on the intestinal tract. *Food and Chemical Toxicology* 45(1): 98-106.
6. Marinalg International, 2012. Status report on the work of marinalg international to measure the molecular weight distribution of carrageenan and pes in order to meet the EU specification: less than 5% below 50,000 daltons. Summary online at http://www.marinalg.org/PDF/SUMMARY_STATUS_REPORT_ON_THE_WORK_OF_MARINALG_INTERNATIONAL_TO_MEASURE_THE_MOLECULAR_WEIGHT_DISTRIBUTION_OF_CARRAGEENAN_AND_PES_IN_ORDER_TO_MEET_THE_EU_SPECIFICATION.pdf Entire report at: http://www.marinalg.org/PDF/3_FULL_Molecular_weight_distribution_of_carrageenan_and_PES.pdf

It should be noted that Marinalg continues the above quotation, "However, of greater significance to consumer safety, are the results of a recent 90-day rat feeding study that has shown no adverse toxicological effect of carrageenan in any of the tests animals. The carrageenan used in this feeding study was selected to contain a high molar mass less than 50,000 Da. it had a water viscosity of 8cps just barely above the 5cps limit." The 90-day study is a subchronic toxicity study, and FDA's Redbook says, "Subchronic toxicity studies with rodents are generally conducted for 90 days (3 months), but they may be conducted for up to 12 months. Results of these studies (1) can help predict appropriate doses of the test substance for future chronic toxicity studies, (2) can be used to determine NOELs for some toxicology endpoints, and (3) allow future long-term toxicity studies in rodents and non-rodents to be designed with special emphasis on identified target organs. Subchronic toxicity studies usually cannot determine the carcinogenic potential of a test substance." (Redbook 2000: IV.C.4.a Subchronic Toxicity Studies with Rodents: Toxicological Principles for the Safety Assessment of Food Ingredients, Chapter IV.C.4.a. Subchronic Toxicity Studies with Rodents, p. 1.)
7. "Carrageenan," October 3, 2011 Technical Evaluation Report, Compiled by ICF for the USDA National Organic Program, available online at <http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateJ&page=NOPNationalList> Lines 483-496.
8. "Carrageenan," October 3, 2011 Technical Evaluation Report, Compiled by ICF for the USDA National Organic Program, available online at <http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateJ&page=NOPNationalList> Lines 533-534.

